

University of Groningen

## Lymphangiogenesis in renal diseases

Yazdani, Saleh

**IMPORTANT NOTE:** You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

*Document Version*

Publisher's PDF, also known as Version of record

*Publication date:*

2015

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Yazdani, S. (2015). *Lymphangiogenesis in renal diseases*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen.

### Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

### Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

# **Lymphangiogenesis in renal diseases**

**Saleh Yazdani**

This project was financially supported by:

*University Medical Center Groningen, Research Institute GUIDE  
Jan Kornelis de Cock Foundation*

Financial support by *ClodronateLiposomes.com* (Science Park in Amsterdam),  
*Dutch Kidney Foundation, University of Groningen, University Medical Center  
of Groningen, Graduate School of Medical Science* for the printing of this  
thesis is gratefully acknowledged.

Cover: Dr. Mojtaba Sadeghi

Publication: Print by Ridderprint BV, The Netherlands

Copyright: Saleh Yazdani, 2015

All rights reserved. No part of this publication may be reproduced, stored or  
transmitted in any form or by any means, electronically or mechanically,  
including photocopy, recording or otherwise without the written permission  
of the author.

ISBN (Ebook): 978-90-367-8445-0



university of  
 groningen

# **Lymphangiogenesis in renal diseases**

## **PhD thesis**

to obtain the degree of PhD at the  
University of Groningen  
on the authority of the  
Rector Magnificus Prof. E. Sterken  
and in accordance with  
the decision by the College of Deans.

This thesis will be defended in public on

Wednesday 2 December 2015 at 12.45 hours

by

**Saleh Yazdani**

born on 20 June 1978  
in Rafsanjan, Iran

**Supervisors**

Prof. G.J. Navis

Prof. H. van Goor

**Co-supervisor**

Dr. J. van den Born

**Assessment Committee**

Prof. S. Florquin

Prof. R.H. Henning

Prof. M.C. Harmsen

***Dedicated to my parents  
and my wife  
with great affection and love***

**Paranimfen**

Ditmer Talsma

Rik Mencke

# CONTENTS

<b>Chapter 1.</b>	General introduction	9
<b>Chapter 2.</b>	Lymphangiogenesis in renal diseases: passive bystander or active participant?	13
<b>Chapter 3.</b>	Vascular endothelial growth factor C levels are modulated by dietary salt intake in proteinuric chronic kidney disease patients and in healthy subjects	39

## ASSOCIATION OF LYMPHANGIOGENESIS WITH RENAL DAMAGE IN DIFFERENT DISEASE CONDITIONS

<b>Chapter 4.</b>	Lymphatic vessels: an emerging participant in the pathology of pre-transplant kidney biopsies?	53
<b>Chapter 5.</b>	Incomplete restoration of Angiotensin II-induced renal damage despite complete functional recovery	69
<b>Chapter 6.</b>	Proteinuria triggers renal lymphangiogenesis prior to the development of interstitial Fibrosis	93

## EFFECTS OF RENOPROTECTIVE INTERVENTIONS ON LYMPHANGIOGENESIS

<b>Chapter 7.</b>	Targeted inhibition of renal Rho kinase reduces macrophage infiltration and lymphangiogenesis in acute renal allograft rejection	115
<b>Chapter 8.</b>	Targeting tubulointerstitial remodeling in proteinuric nephropathy in rats	131
<b>Chapter 9.</b>	General discussion/prospects	155
	Samenvatting	161
	Acknowledgement	167